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DETERMINING CRITICAL METEOROLOGICAL AND OCEANOGRAPHIC FACTORS AT THE OPERATIONAL LEVEL OF WAR

by

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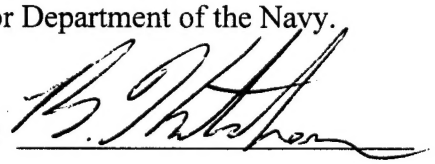
A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Joint Military Operations Department.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or Department of the Navy.

Signature: 

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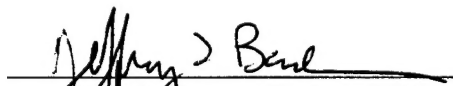

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Abstract of

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INTRODUCTION

Everybody talks about the weather, but nobody does anything about it.

Mark Twain

In preparing the theater or area of operations, actions that an Operational Commander takes prior to the initiation of military operations can assist in determining the shape and character of the operation. One of these actions is to clearly understand the Meteorological and Oceanographic (METOC) conditions* of the theater or area of operations and their affects on the planned operation. METOC conditions will always affect military operations and can be a key factor in the success or failure of an operation. The Commander who best understands METOC conditions and takes advantage of them will have a decided advantage over his opponent. At the operational level of war, determining the affects of METOC conditions is complex because they affect almost every operational function. An orderly and thorough process is required to determine the critical METOC factors of an operation. Critical METOC factors are the METOC conditions that positively or negatively impact friendly and enemy capabilities, and affect the ability of the Commander to achieve operational objectives. Determining critical METOC factors requires the Operational Commander to understand the METOC conditions; their affects on friendly and enemy personnel, sensors, platforms and, weapons and then determine which METOC conditions are necessary to achieve victory and which will prevent victory. These conditions and their affects are the critical METOC factors which help the Commander formulate a concept of operations to accomplish the mission. Not determining critical METOC factors gives

* Meteorological and Oceanographic facts pertaining to the atmosphere and oceans such as wind, temperature, cloud cover, wave height, salinity and other phenomena which affect military operations.

the Commander a disjointed view of METOC affects on the operation and increases the potential to make poor operational decisions.

This paper provides historical cases of military operations to show the results of adequate and inadequate planning for the affects of METOC conditions on military operations. The paper then provides a process and considerations required to determine critical METOC factors for a military operation.

A HISTORICAL PERSPECTIVE OF METOC CONDITIONS ON WARFARE

The affects of METOC conditions on military operations is well documented throughout the history of warfare. METOC conditions have been an advantage to some warriors and an impediment to others. Operational Commanders intuitively know that METOC conditions will affect their operation. Despite this fact, often a determining factor between success and failure has been how well METOC conditions were accounted for in the operational planning.

While Gengis Kahn was planning his final campaign against the Persians, he knew the Persian forces were widely separated but outnumbered his Mongols. The Mongols knew how to conduct operations during winter while the Persians did not. To prevent the Persians from joining their forces, Gengis timed the campaign to begin in the winter and defeated the Persians in piecemeal fashion.[1]

Napoleon's Grand Armee , which had defeated almost all of Europe, was nearly wiped out during the invasion of Russia. Napoleon was aware of the severity of the Russian winter but discounted its affects on his army.[2] The rain, mud, bitter cold and snow that Napoleon encountered on his retreat from Moscow and the lack of preparedness for the harsh conditions, all contributed to his army's defeat by the

Russians.[3] Hitler's Wehermacht suffered the same consequences in their invasion of Russia in World War II. Operation Barbarossa was calculated to take five months to complete, however the German planners did not adequately plan for the Russian winter.[4] The bad weather blunted Blitzkrieg tactics, there was a shortage of winter clothing and shelters, and equipment malfunctioned in the bitter cold.[5] The Germans were unable to overcome their inadequate planning and they were subsequently driven from Russia.

During the course of World War II, METOC considerations were key factors in operational planning for the Allies. The most crucial was in planning the timing for the launch of Operation Overlord. In the early stages of the planning there was no time period set for the invasion except, that it would not occur before May. The Supreme Commander, not yet appointed, would have to review all the factors before making a decision on timing.[6] METOC conditions were one of the factors involved in the decision-making process. After developing a list of METOC requirements, meteorologists studied the climatology** of the region and determined May and June to be the best months to conduct the invasion.[7] This information played a significant role in the decision to launch of Overlord in June.[8]

In the Korean war, the North Koreans timed their invasion of South Korea to coincide with the onset of the summer monsoon.[9] The North Koreans planned to use the poor flying weather of the summer monsoon to neutralize the capability of United States aircraft. The North Koreans overestimated the affects of the monsoon weather

** Climatology is the scientific study of the climate and oceans and is the tool that is used to develop long-range forecasts.

on the Air Force and were quickly forced to abandon daytime operations because of the success of American close air support and air interdiction efforts.[10]

During the Vietnam War, Operation Linebacker II was designed with the objective of bringing the North Vietnamese back to the negotiating table to sign a peace settlement. The operational plan stressed a maximum effort in a minimum amount of time.[11] Air Force planners had anticipated the need to conduct air operations during the winter monsoon which would make the use of precision guided munitions (PGM) difficult. In August they reviewed the target lists to select targets that could be bombed by all weather aircraft and when President Nixon needed a bombing plan in December for Linebacker II, the military was ready with a plan that was able to obtain the objective.[12] The North Vietnamese, on the other hand, thought the winter monsoon conditions would help keep them safe by preventing U.S. fighter-bombers from bombing north of the 20 th parallel. Linebacker II surprised the North Vietnamese leadership and shocked them with the magnitude and destruction of the bombing, which was able to continue night after night despite the winter monsoon weather.[13]

These examples show the results of operational planning that did and did not adequately take into account METOC factors. At the operational level, a Commander must consider many factors during the planning process in order to select the best means of achieving the desired objective; critical METOC factors are one of them. Determining critical METOC factors is complex and requires a process that is orderly and thorough. The first step is to determine the METOC conditions of the theater or area of operations.

USING CLIMATOLOGY TO DETERMINE METOC CONDITIONS

Whether conducting deliberate or crisis action planning, determining the possible METOC conditions for an operation will require the use of climatology. Climatology is based on historical data and provides the average METOC conditions and a statistical representation of the range of METOC conditions in a region. The Commander must avoid planning for just the average METOC conditions. Operational planning requires knowledge of the whole spectrum of conditions and the probability of their occurrence in order to adequately assess the potential impact of METOC conditions on the operation.

The Commander needs to be aware of the amount of data used in developing the climatology. An inadequate number of observations can skew the statistics presented or, more importantly, miss rare, but potentially significant METOC conditions. Conducting military operations in remote areas of the world increase the probability of having limited METOC data, requiring assumptions be made, and conclusions be drawn about the METOC characteristics of the theater or area of operations. Being aware of limited data and the uncertainty and risks associated with it, the Operational Commander can weigh the risks and make timely, informed decisions on how to deal with it.

If only the average conditions are considered and/or the data in the area is sparse, unexpected conditions can occur that adversely affect the operation; the Iranian hostage rescue, Operation Eagle Claw , is an example.

In order to avoid Iranian radars, the Eagle Claw mission was to be flown at low level and required visual meteorological conditions(VMC) enroute. During the flight

from the aircraft carrier to a remote landing site (Desert One), the helicopter force (one helo had already aborted because of mechanical difficulties) encountered suspended dust in the air which precluded VMC flight. As a result, flight integrity was lost, one helicopter aborted and, the remaining helicopters were 85 minutes late to Desert One. The inadequate number of helicopters and their late arrival at Desert One caused Eagle Claw to be aborted.[14]

During the planning of Eagle Claw the Air Weather Service (AWS) team assigned to the Joint Task Force (JTF) researched the climatology for the area to identify non-VMC weather conditions the aircrews could encounter in Iran. Suspended dust was one of the conditions identified and was included in the Operation Plan weather annex.[15] However, the climatology showed a high probability of clear weather and therefore, alternatives for executing Eagle Claw under conditions other than VMC were not developed.[16] The pilots of the helicopters were not briefed on the possibility of suspended dust and the operational planners did not establish a weather criteria for mission abort. When the pilots encountered the dust, they were unprepared to accurately assess the impact of non-VMC conditions on their flight. If the pilots had been aware of the suspended dust phenomenon and an abort criteria had been established they could have made an informed decision to abort enroute and possibly preserve the option to launch the mission later.[17]

It is unrealistic to try and plan for every METOC condition that occurs in the area; the Commander must decide what METOC conditions are important enough to plan for. Depending on the mission, the Commander may not consider a thirty percent chance of gale force winds critical but does consider a ten percent chance of fog critical. Using

climatology to understand the METOC characteristics of the theater or area of operations is the first step in determining critical METOC factors. This knowledge must then be used to determine the affects of the various METOC conditions on friendly and enemy capabilities.

DETERMINING THE AFFECTS OF METOC CONDITIONS ON CAPABILITIES

To determine how METOC conditions affect capabilities, the Commander must know the range of METOC conditions personnel, sensors, platforms and, weapon systems can operate in and a set of METOC threshold and critical values*** must be established. Applying these values to the climatology will allow the Commander to determine how much and how often the METOC conditions will affect forces in the theater or area of operations.

Currently, determining established threshold and critical values for sensors, platforms, and weapon systems is both time consuming and difficult. Either the data is in multiple publications, and somtimes conflicting, or the values have not been established. These values take into account the capability of the sensors, platforms and weapons as well as operational considerations. The threat will play a role in determining these values. For instance, heavy anti-aircraft artillery (AAA) may prevent low level air strikes therefore high cloud ceilings may be required to employ precision guided munitions (PGM) or conduct reconnaissance. Restraints, such as a requirement to limit collateral damage may also play a role in determining the METOC threshold and critical values for the operation. Therefore, the Commander will have to ensure the criteria for the planners to use is available and correct. Using the wrong threshold or

*** Threshold Value - the value which a METOC parameter begins to adversely affect performance
Critical Value - the value which a METOC parameter prevents effective performance

critical values when planning an operation can lead to poor operational decisions which is what occurred in Operation Delaware.

Operation Delaware, a helicopter assault on the A Shau Valley during the Vietnam War, had the objective of preventing the enemy from massing for further attacks in the vicinity of Hue. On 10 April, 1968, the 1st Cavalry Division (Airmobile) was ordered to begin plans for the withdraw from Khe Sanh and conduct of Operation Delaware. The urgent nature of the operation was predicated on a long-range forecast that April would be the last period of favorable weather for an air assault operation before the onset of the heavy, summer monsoon rains.[18] The long range forecast was based on climatology from old French records.[19] The climatology was accurate in determining the onset of the summer monsoon however, the forecast and timing were predicated on the wrong METOC parameters and critical and threshold values. The weather throughout April was characterized by low cloud ceilings, fog and, thunderstorms which wreaked havoc on air operations. The Army lost 33 helicopters during Operation Delaware, primarily because low cloud ceilings increased their vulnerability to anti-aircraft fire.[20] Weather was a key planning factor in the timing of Operation Delaware from the beginning. Unfortunately, the decision on when to start the operation was based on the inches of rain expected during the summer monsoon, not ceilings and visibility required for an air assault. In 1973, Major General Tolson, Commander, 1st Cavalry Division (Airmobile) during Operation Delaware stated:

> *An air cavalry division can operate in and around the scattered monsoon storms and cope with the occasional heavy cloudbursts far better than it can operate in extremely low ceilings and fog. ... The lesson learned then, was that one must be careful to pick the proper weather indices in selecting an appropriate time for an air mobile operation....*[21]

The goal of these two steps is to ensure the Commander looks at the right parameters and asks the right questions in order to correctly identify the threshold and critical METOC values.

USING OPERATIONAL ART TO DETERMINE CRITICAL METOC FACTORS

JCS Pub 3-0 recognizes the importance of METOC considerations in operational planning:

> *Seasonal effects on terrain, weather, and sea conditions can significantly affect operations of the joint force and should be carefully assessed before and during operations.*[22]

After applying the METOC conditions of the theater of operations to the threshold and critical METOC values for all the systems, sensors and weapons and personnel there will be a large number of combinations of conditions and affects. These combinations by themselves, do not give the Commander a coherent view of the affect of METOC conditions on the operation. To achieve this the Commander must sort through the conditions and effects to determine critical METOC factors. It is important that the Commander look beyond the numbers in order to determine which METOC conditions affect an operational function and how. A METOC condition may not affect one operational function but could inhibit another. This is the problem that Allied Meteorologists had in planning for Operation Overlord.[23] Conflicting or overlapping requirements can be particularly prevalent in joint and multinational operations where varying systems, capabilities and doctrines must be accounted for. Therefore, a framework must be established to enable the Operational Commander to adequately assess the many combinations and determine the critical METOC factors for an operation. Not using a framework to determine critical METOC factors was a weakness

in the planning of Operation Shingle, the amphibious landing at Anzio during World War II.

Operation Shingle was designed to break the stalemate that had occurred on the Italian mainland. The operational plan for Shingle was flawed from the beginning; one of the flaws was in the planning for the affects of the METOC conditions. The planners knew that bad weather and poor beaches would make the landing difficult and high seas would complicate the logistics problem. Considerable effort went into the logistics planning to overcome the affects of the METOC conditions and a plan was devised to offload all the logistics in two days. The operational planners, however, failed to fully account for the affects of the same conditions on the flow of forces ashore. One of the assumptions the planners had made was that the Germans would put up a strong defense and subsequently counterattack. [24] Fortunately this did not occur because the majority of Shingle's armor was not ashore at the end of the first day because of delays caused by rough seas. The planners also did not adequately consider the affects of the METOC conditions on the ability of Shingle's forces to achieve their objectives. The terrain, mud and flooded areas made the plain before the Alban hills, in wintertime, the wrong place to fight a battle. [25]

At the operational level of war, applying operational art helps to ensure that Commanders use assets and time effectively to achieve goals through operational design. The operational design provides a framework to help Operational Commanders understand the conditions for victory and order their thoughts.[26] The operational scheme is the essence of operational design.[27] Applying the affects of METOC

conditions to the development of an operational scheme also provides the framework for the Commander to identify the critical METOC factors for the operation.

The following is a list of elements in an operational scheme where the affects of METOC conditions are a factor. It is not intended to be an exhaustive list of elements or provide every operational METOC consideration.

Method of defeating the opponent. The Commander will decide on a direct or indirect approach to defeat the enemy. A direct approach can be used when friendly combat power is overwhelming, an indirect approach can be used if it is not.[28] The determination of relative combat power is not simply a comparison of a list of forces and weapons for each side. A determination of relative combat power also includes intangible combat multipliers or combat reducers. METOC conditions can be either combat reducers or multipliers depending on the mission.[29] The Commander must determine the affect of METOC conditions on combat power for both friendly and enemy forces before determining the method of defeating the opponent.

Application of forces and assets. The Operational Commander will designate the sectors of main effort and secondary effort. When applying forces and assets in the sector of main effort, the Commander must ensure synchronized employment of combat forces and have forces adequate to quickly accomplish the mission[30]. Consideration must be given to METOC conditions that inhibit or degrade the use of systems, sensors or weapons, causing synchronization problems or require additional forces to accomplish the mission.

Operational Maneuver. Operational maneuver consists of moving forces from their base of operations and along their lines of operation to strike an operationally

significant objective. Operational maneuver requires timely and reliable operational reconnaissance and intelligence[31]. The Commander must plan for METOC conditions that preclude or inhibit moving along the line of operation to the objective. He must also look at conditions that may preclude reconnaissance of the area.

Operational Fires. Effective and timely operational fires facilitate operational maneuver by one's own forces. They can also be used to isolate the area of operations and attack critical enemy functions and facilities. Effective operational reconnaissance and intelligence are critical to selecting targets for operational fires.[32] The Operational Commander must plan for METOC conditions that will preclude or inhibit attacking critical targets with a particular system and consider alternative methods to attacking the target. Again, the Commander must consider conditions that would impact operational reconnaissance.

Sequencing. Sequencing is the arrangement of events within an operation in the order most likely achieve the elimination of the enemy's center of gravity.[33] The Commander must consider METOC conditions that affect the sequence chosen. For example, the sequence may have the ground campaign beginning at the start of the rainy season. If this will prevent the ground forces from achieving their objectives, an alternative sequence of events will need to determined.

Synchronization. Synchronization is "the ability to focus resources and activities in time and space to produce maximum relative combat power at the decisive point."[34] For synchronization to be effective the combined elements must generate effects that exceed the sum of their individual efforts.[35] The Commander must account for METOC conditions that inhibit or preclude using a particular capability such as amphibious

assault, special forces, airlift and may need additional forces allocated to the problem. Synchronization should be event driven.[36] The Commander needs to plan for METOC conditions that delay or inhibit a crucial event.

Phasing. Phases may occur sequentially or simultaneously. When deciding on the phasing of an operation the Commander needs to consider force requirements, force deployment and, supporting actions.[37] The Commander must plan for METOC conditions that prevent forces from arriving on time or, degrade the forces capability to such an extent that additional forces or time is required to complete the phase.

Timing and tempo. An operation should be conducted at a point in time and at a tempo that exploits friendly capabilities and inhibits the enemy.[38] The Commander needs to consider the time of the year when METOC conditions optimize the operation for friendly forces or inhibits enemy forces. He must also plan for METOC conditions that will affect the time to complete a particular event. When considering the tempo of an operation, the Commander needs to understand how the METOC conditions will affect men and material, particularly in extreme conditions. The affect of METOC conditions may require an operational pause to be built into the plan.

Operational Momentum. The speed of movement and actions by friendly forces are the keys to maintaining momentum. The Commander needs to consider the type of force to employ that can maintain speed and strike effectively at the enemy.[39] The Commander must plan for METOC conditions that affect his forces' ability to strike targets, mobility and, resupply. The Commander also needs to consider the affects of METOC conditions on the ability of the enemy to react.

Branches and sequels. Branches and sequels are a way to build sufficient flexibility into a plan. Branches are options built in the basic operations plan. Sequels are subsequent operations based on the possible outcome of operations in progress. The use of branches and sequels accelerate the operational decision making cycle, allowing the Operational Commander to act faster than his opponent.[40] The Commander can develop a plan based on the most probable METOC conditions and build branches and sequels using METOC conditions that will allow or prevent the successful completion of an operation or tactical action as the go/no go criteria. This will enable the Commander to quickly shift to another option and continue the operation if METOC conditions degrade below the required minimums for the plan or better than expected conditions occur.

Operational Sustainment. Logistics is one of the critical elements of combat power. When planning an operation, sufficient time must be given for logistical build-up. An inadequate level of sustainment to the Operational Commander may place restrictions on the timing and sequencing of operations and limit options for operational maneuver. Identification of logistical constraints to an operation is critical to operational success.[41] The Commander must determine what METOC conditions will limit logistics operations and develop plans to overcome them. He must consider METOC conditions at both the points of embarkation and debarkation and along the lines of communication.

Combining the affects of METOC conditions with the elements of operational design, the Commander can determine critical METOC factors. The Commander can then use the critical METOC factors to form the basis for plans and set the conditions

for successful completion of the mission, and again when deciding on a course of action to pursue.

CONCLUSION

Carl Von Clausewitz wrote, "Everything in war is simple, but the simplest thing is difficult."[42] Determining critical METOC factors is difficult but necessary for the successful conduct of war. The determination of critical METOC factors will enhance a Commander's boldness rather than hamper it. Boldness will almost always triumph over timidity. However, boldness must be supported with fact so that assets and time are not wasted. Risk is inherent in military operations. Operational planning helps to manage risk by clarifying problems and devising integrated solutions to complex problems; determining critical METOC factors must part of the planning process. By knowing the risks involved before making a decision, the Commander can act decisively to take advantage of opportunities, or minimize the impact of problems. Nothing can be done to change METOC conditions, but knowledge of what type of METOC conditions to expect and their affects enables the Commander to anticipate problems and opportunities and be ready to act, not react.

War is an art not a science. The subjective nature of war prevents a strict, mathematical approach to its planning or conduct. However, combining principles of science with the principles of war enhances a warfighter's chances of victory. In war, the affects of METOC conditions are never neutral. As Sun Tzu observed over 2000 years ago, the advantage is on the side that knows the weather.[43]

NOTES

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